

What is claimed is:

1. A liquid chromatographic system including:

at least one pumping system;

a plurality of flow cells;

a plurality of photodetectors;

said pumping system supplying solvent to at least one flow cell of said plurality of flow cells

a plurality of light sources;

each of at least some light sources of said plurality of light source applying light to a corresponding one said plurality of photodetectors after the light has passed through a corresponding one of said flow cells;

a time division multiplex circuit having a plurality of input means and a multiplex cycle time during which it multiplexes at least some of said plurality of input means whereby it conducts signals from each individual input means of said some of said plurality of input means for a stroke time; and

at least one circuit means arranged to receive energy from at least one of said photodetectors for a substantial portion of said multiplex cycle time and apply it to a corresponding one of said plurality of multiplex circuit input means during said stroke time.

2. A liquid chromatographic system in accordance with claim 1 in which said at least one circuit means is a non-switching circuit with low bandwidth, whereby sensitivity is improved.

3. A liquid chromatographic system in accordance with claim 2 in which said at least one circuit means has a fast rise time, flat topped response to an impulse and a pulse duration that lasts at least a substantial portion of the multiplex cycle time.

4. A liquid chromatographic system in accordance with claim 2 further including:
a first light guide receiving light from said light source and transmitting it to said at least one photodetector; and

a second light guide positioned to receive light from said first light guide and transmit it to a second photodetector;

said first and second light guides having their ends positioned within a flow cell adjacent to each other so that light passes from an end of said first light guide through solute in said flow cell and into an end of the second light guide, whereby light is diminished within said flow cell by absorbance by solute.

5. A liquid chromatographic system according to claim 4 in which said ends of said first and second light guides are spaced in the region of .02 to 5 millimeters apart.

6. A liquid chromatographic system according to claim 5 in which said light source includes:

at least one lamp;

means for focusing light from said at least one lamp onto a diffraction grating;

means for focusing light from the diffraction grating onto an opening; and

at least some of a plurality of light guides having an end in said opening whereby said at least some of said plurality of light guides receive light from said diffraction grating.

7. A liquid chromatographic system in accordance with claim 6 including at least one column wherein:

said at least one pumping system comprises a plurality of pumps;

said at least one column comprising a plurality of columns, each of said plurality of columns communicates with a different one of said plurality of pumps;

said at least one photodetector comprises a plurality of photodetectors, each of said plurality of photodetectors communicating with a different one of said plurality of columns, whereby each of said detectors detects a signal; and

said photodetectors including a photodiode positioned against one end of said second light guide.

8. A liquid chromatographic system in accordance with claim 7 in which each of said light guides is in intimate contact with a different photodiode.

9. A method of performing chromatography comprising the steps of:

pumping solvent through a plurality of flow cells;

transmitting light through at least one of said plurality of flow cells to a plurality to a corresponding one of a plurality of photodetectors;

multiplexing signals from at least a some of said plurality of photodetectors during a multiplex cycle time during at least one of said plurality of a plurality of signals from at

least one of said plurality of photodetectors being conducted to an output terminal occurring during one stroke portion of said multiplex cycle time; and

transmitting energy from said at least one of said photodetectors for a substantial portion of said multiplex cycle time and apply it to a corresponding one of said plurality of multiplex circuit input means during said stroke time.

10. A method of performing liquid chromatography in accordance with claim 9 further comprising the steps of:

transmitting light through said at least one photodetector from a first light guide; receiving light passing through solute from said first light guide to a second light guide; and

transmitting light received by said second light guide to a second photodetector, wherein said first and second light guides have their ends positioned within a flow cell adjacent to each other so that light passes from an end of one light guide through solute in said flow cell and into an end of the second light guide, whereby light is diminished within said flow cell by absorbance by solute.

11. A method according to claim 10 in which said step of transmitting light includes the substeps of:

transmitting light from at least one lamp;

focusing light from said at least one lamp onto a diffraction grating; and

focusing light from the diffraction grating onto an opening wherein at least some of a plurality of light guides having an end in said opening whereby said at least some of said plurality of light guides receive light from said diffraction grating.

12. A method in accordance with claim 11 further including the step of detecting light with photodiodes positioned against one end of said second light guide.

13. A multiplex system for measuring a plurality of sources, comprising:
a plurality of sources of signals representing measured values;
a time division multiplex circuit having a plurality of input means at least some of which are arranged to receive signals from a corresponding one of said source of signals in said plurality of sources of signals representing measured values;

said time division multiplex circuit having a multiplex cycle time during which it multiplexes at least some of said plurality of input means whereby it conducts signals from each individual input means of said some of said plurality of input means for a stroke time;
and

at least one circuit means arranged to receive energy from at least one of said sources of signals for a substantial portion of said multiplex cycle time and apply it to a corresponding one of said plurality of multiplex circuit input means during said stroke time.

14. A multiplex system in accordance with claim 13 in which said at least one circuit means is a non-switching circuit with low bandwidth, whereby sensitivity is improved.

15 A liquid chromatographic system in accordance with claim 14 in which said at least one circuit means has a fast rise time, flat topped response to an impulse and a pulse duration that lasts at least a substantial portion of the multiplex cycle time.

16. A method of multiplexing signal sources, comprising the steps of:

multiplexing signals from at least a some of said plurality of signal sources during a multiplex cycle time during at least one of said plurality of a plurality of signals from at least one of said plurality of signal sources being conducted to an output terminal occurring during one stroke portion of said multiplex cycle time; and

transmitting energy from said at least one of said signal sources for a substantial portion of said multiplex cycle time and applying it to a corresponding one of said plurality of multiplex circuit input means during said stroke time.

17. A multiple channel liquid chromatographic system, comprising :

at least two syringe pumps for pumping solvent in said system wherein each of said at least two syringe pumps includes a piston and a cylinder;

a moving frame attached to at least two pistons of said two syringe pumps, wherein movement of each of the pistons with respect to a corresponding cylinder of said syringe pumps is carried out by the moving frame.

at least one time-proportioning electronically controllable liquid gradient switching valve;

a first mixing means;

a second mixing means;

said second mixing means being a pump cylinder with an offset inlet that forms eddy currents in the pump cylinder;

the first mixing means residing in a fluid flow path between the at least one time-proportioning electronically controllable liquid gradient switching valve and the said at least one of said at least two syringe pumps inlet and the second mixing means resides in the cylinder of the at least one of said at least two syringe pumps downstream of the inlet of the at least one time-proportioning electronically controllable liquid gradient switching valve; wherein the fluid flow path between the said at least one time-proportioning electronically controllable liquid gradient switching valve and the at least one of said at least two syringe pumps inlet is a flow passageway sized to produce formation of elongated streams of first and second solvents withmixing in the said passageway, which in combination with mixing caused by eddy currents in the pump cylinder makes each step of the gradient sufficiently flat and reproducible for a desired set of chromatographic separation processes.

18. A multiple channel liquid chromatographic system in accordance with claim 17 wherein the flow passageway has a volume less than one-tenth that of a single charge, wherein the flow passageway has a diameter of less than one-half the diameter of the pump cylinder; said flow producing good axial mixing and poor transverse mixing on a small scale charge and an outlet of said flow passageway injecting into the pump cylinder where the flow becomes turbulent flow thus enhancing transverse mixing and axial mixing on a large scale.

19. A multiple channel liquid chromatographic system in accordance with claim 18 wherein the flow passageway has a volume of at least one-tenth that of a single charge; said flow producing good axial mixing on a small scale and an outlet of said flow passageway injecting into the pump cylinder where the flow undergoes enhanced transverse mixing.

20. A multiple channel liquid chromatographic system in accordance with claim 18 wherein the flow passageway has a volume of at least one-tenth that of a single charge wherein the distance required for further transverse mixing is small; said flow producing good axial mixing and an outlet of said flow passageway injecting into the larger diameter pump cylinder where the flow becomes turbulent and undergoes transverse mixing and axial mixing.

21. A multiple channel liquid chromatographic system in accordance with claim 19 in which said at least one time-proportioning electronically controllable liquid gradient switching valve is arranged to produce consecutive pulses of liquid from at least one of said at least two sources of liquid to a refill inlet at a fluid velocity high enough to induce turbulent mixing in a space between a head of said piston and that part of the cylinder not occluded by the piston.

22. A multiple channel liquid chromatographic system in accordance with claim 21 further including means for synchronizing the at least one time-proportioning electronically controllable liquid gradient switching valve with refill movement of said piston so that one

charge of each desired fluid at a desired volume proportion is deposited in each pump and mixed to form at least one part of a step of a stepped gradient.

23. A multiple channel liquid chromatographic system in accordance with claim 22 further including:

first means for shutting off fluid flow between the said pump and said at least one time-proportioning electronically controllable liquid gradient switching valve during delivery;

second means for synchronizing the at least one time-proportioning electronically controllable liquid gradient switching valve with refill movement of said piston so that one charge of each desired fluid at a desired volume proportion is deposited in each pump and mixed to form at least one part of a step of a stepped gradient; and

control means for repeating the said first and second means at consecutively different or same fluid proportions to produce an entire stepped gradient.

24. A multiple channel liquid chromatographic system in accordance with claim 23 wherein at least two equal charges of each of two fluids are alternately delivered to an inlet of at least one of said at least two syringe pumps; said two fluids being mixed in the at least one time-proportioning electronically controllable liquid gradient switching valve during a rapid, energetic refill, and then delivered as a single step of a step gradient to the rest of said system in the order of sample injection device, chromatographic column, and fraction collector.

25. A method of performing liquid chromatography comprising:

drawing at least first and second fluid solvent into a plurality of pumps from at least a corresponding first and second source of fluid;

pumping said fluid from said plurality of pumps;

said step of pumping said fluid including the step of mixing said at least first and second fluids in said pumps whereby a gradient is formed;

said step of mixing including the step of mixing said at least first and second fluids prior to pumping said at least first and second fluids from said pumps;

said step of mixing further including the step of drawing said first and second fluids through at least one flow path, wherein the flow path is shaped to produce good axial mixing and poor transverse mixing by stretching out flow streams of each of said first and second fluids; and

injecting said fluids into a pump cylinder where it undergoes enhanced transverse mixing and axial mixing from eddy currents in the pump cylinder.

26. The method of claim 25 wherein the enhanced mixing occurs because the axially-mixed liquid entering the pump facilitates further mixing because the distance required for further transverse mixing is small.

27. A method according to claim 26 wherein the enhanced mixing occurs because the tendency of some pairs of liquids not to mix at their interfaces decreases because this interface is already degraded at or before the outlet of flow means.